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ABSTRACT

This chapter outlines the measurement and interpretation of cognitive style using the conceptual structure of Educational Cognitive Style and the Educational Sciences developed by Dr. Joseph Hill and others. The measurement and interpretation of 36 aspects of cognitive style are discussed, as well as the use of cognitive style mapping (the graphic interpretation of cognitive style inventory responses) in describing the instructional environment of different types of instructional approaches. The use of cognitive mapping in matching the students' and instructor's cognitive styles to that of the instructional method is also described. A model developed under the auspices of the National Special Media Institutes (NSMI) is also discussed, with emphasis on its use for individualizing and personalizing instruction using cognitive style as the center of the organization. The text is supplemented with 3 figures, and a 13-item bibliography is provided. (Author/EW)

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CHAPTER VI

COGNITIVE STYLE MAPPING: ITS PLACE IN INSTRUCTIONAL DEVELOPMENT

By
Ronald K. Bass and James D. Hand

One of the primary reasons for the steadily growing support for instructional development, both in America and the rest of the world, is the common sense approach taken by its advocates toward educational problems (both anticipated and real). The idea that one cannot fully understand a problem until one understands all its component parts, and their interactive factors, is integral to I.D.

Numerous models for and approaches to instructional development have been developed by individual educators and educational institutions. The military relies heavily upon I.D. techniques (Air Force – *Handbook for Designers of Instructional Systems*, Navy – *Job Training Course Design and Improvement*, Army – *Systems Engineering of Training)*. Many commercial agencies have undertaken the development and marketing of packages designed to train educators in the concepts of instructional development ("Systems Approach for Education," Corregain Associates; "Criterion Referenced Instruction," Mager Associates; "Designing Effective Instruction," General Programmed Teaching; "Learning Systems Design," McGraw Hill; and others).

The approaches advocated and the models developed by these individuals and by educational, military, and commercial agencies vary in structural development, ranging from the four-step model developed by DeCecco (1968) to the 60-step "maxi" model developed by Abedor (1971) and therefore have obvious differences in complexity and specificity. There is, however, consistency in the inclusion of the basic areas: define or analyze, develop or design, and evaluate. Thus, even though the models are different, the basic approach is the same.

For purposes of this analysis, only one model will be utilized, the model developed under the auspices of the National Special Media Institutes (NSMI), a consortium of Syracuse University, The University of Southern California, Teaching Research of Oregon, and Michigan State University. The model covers the three basic areas common to most models – define, develop and evaluate – and the areas are further broken down to form a nine-step instructional development model (Figure 1).

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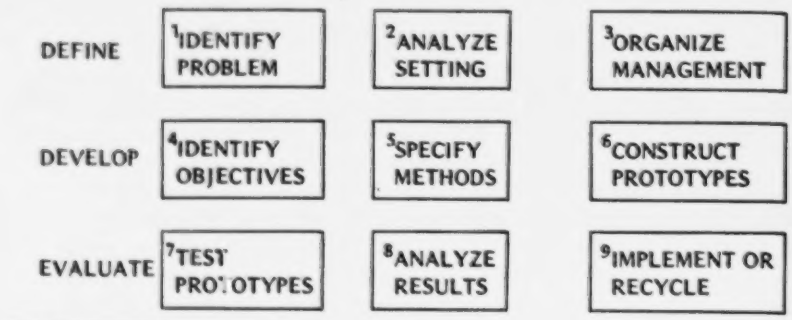
Figure 1. NSMI Instructional Development Model.



The above model and other models have been used relatively effectively to solve instructional problems. However, there are several areas (steps) of the model in which more information than is normally gathered is needed if optimum decisions are to be made (steps 2, 5, 6, 8 and 9 — the steps where individual differences are most important).

One of the least understood and most complex components of any educational system is its students. It is not enough to know the age, sex, socio-economic background, family life and I.Q. of students. While this information is valuable, research data derived from studies employing these factors correlated very poorly with student success in using different forms of instruction. The employment of psychological factors (such as field dependence/independence, concrete/abstract thinking, dominance, assertiveness, nurturance, perseverance, romanticism, and idealism) has also provided precious little useful information concerning the interaction of a learner with instruction of a particular form in a particular instructional setting.

The general failure of educational research to provide meaningful data concerning the interaction between the learner and the instruction and between the learner and the instructional setting is attributable, in large part, to the practice of researching one characteristic of the learner at a time.

Picture this situation, not uncommon at all in the literature. One hundred students are tested for field dependence/independence. Fifty are found to be field-dependent (D) and fifty are found to be field-independent (I). The researcher wishes to explain learner achievement in interaction with a videotaped lecture (VT) and learner achievement in interaction with a printed copy of the lecture (PR), in terms of learner's degree of field dependence/independence. A 2 x 2 factorial is established thusly:

	D	I
VT	N=25	N=25
PR	N=25	N=25

Even if the learners are matched to account for pre-test scores, I.Q., or some other factor; even if the lecture is analyzed to determine whether the information is presented inductively or deductively; there yet remain factors interacting within the system which have not been accounted for.

The intent of this type of research is to study discrete variables in as "clean" a way as possible. The problem inherent in this approach is that learners, instructors, and instructional settings are *not* discrete variables. Until very recently it was impossible to investigate interactions of the learner *as a whole* with instruction. With the development by Joseph E. Hill of Oakland Community College in Bloomfield Hills, Michigan of a framework known as the Educational Sciences and of a construct known as educational cognitive style mapping, the possibility for this type of research has become manifest and the construct is being used extensively in many locations across the country as the basis for individualization or personalization of instruction.

Educational cognitive style provides a profile of the individual student's strengths and weaknesses which might affect his education, a profile showing how he comes to know. This increase in valuable information, as to the individual differences of students, affords a much better opportunity for the appropriate design of instruction.

The goal of the Educational Sciences, then, is to provide information concerning the interactions between the student and the instruction and between the student and the setting in which the student learns. There has now been twenty years of research using educational cognitive style; this research has yielded much information concerning the prescription of educational treatments for students.

EDUCATIONAL COGNITIVE STYLE

The theoretical construct of educational cognitive style is composed of the following four sciences:

1. Symbols and their meanings (29 elements)
2. Cultural Determinants (3 elements)
3. Modalities of Inference (5 elements)
4. Electrophysiological and Biochemical Aspects of Memory Function

For practical purposes, however, only three of these sciences are currently being utilized in the design of instruction.

SYMBOLS AND THEIR MEANINGS is an area in which students are assessed as to their abilities to utilize both the theoretical and qualitative symbols. Theoretical symbols are those having to do with written or spoken words or numbers and qualitative symbols are those having to do with the senses and feelings, commitments, and values.

The elements assessed under symbols and their meanings are: (Hill, 1971) (Hill, 1975).

THEORETICAL SYMBOLS

1. T(AL): Theoretical Auditory Linguistic – the ability to gain information from the spoken word.
2. T(VL): Theoretical Visual Linguistic – the ability to gain information from the written word.
3. T(AQ): Theoretical Auditory Quantitative – the ability to gain information from the spoken number.
4. T(VQ): Theoretical Visual Quantitative – the ability to gain information from the written numeral.

QUALITATIVE SYMBOLS

There are twenty-five (25) qualitative symbols. Five of them are associated with sensory stimuli.

1. Q(A): auditory – the ability to perceive meaning through the sense of hearing.
2. Q(O): olfactory – the ability to perceive meaning through the sense of smell.
3. Q(S): savory – the ability to perceive meaning by the sense of taste.
4. Q(T): tactile – the ability to perceive meaning by the sense of touch.
5. Q(V): visual – the ability to perceive meaning by the sense of sight.

Ten of the qualitative symbols are programmatic in nature, and as such, can be thought of as "sixth senses."

1. Q(PF): Qualitative Proprioceptive (Fine) – ability to synthesize a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., playing a musical instrument, typewriting); or into an immediate awareness of a possible set of interrelationships

between symbolic mediations, i.e., dealing with "signs." While qualitative proprioceptive fine symbolic intelligence is most readily observable in seemingly automatic motor responses such as reading and playing music, certain types of theoretical symbolic mediation also require qualitative proprioceptive activity. For example, the synthesis of a number of symbolic mediations is evident when an individual upon seeing a sign of smoke immediately interprets it as evidence of fire and experiences an interplay of many sensations including smell of smoke, taste of smoke, and sensation of heat. In this instance, a network of previous experiences and related associations produces the theoretical mediation of fire along with the other qualitative aspects.

2. Q(PG): Qualitative Proprioceptive (Gross) – ability to synthesize a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball, skiing).

3. Q(PDF): Qualitative Proprioceptive Dextral (Fine) – a predominance of right-eyed, right-handed and right-footed tendencies (a typically right-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., writing right-handed).

4. Q(PDG): Qualitative Proprioceptive Dextral (Gross) – a predominance of right-eyed, right-handed and right-footed tendencies (a typically right-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball with the right hand).

5. Q(PKF): Qualitative Proprioceptive Kinematics (Fine) – ability to synthesize a number of symbolic mediations into a performance demanding the use of fine musculature while monitoring a complex physical activity involving motion.

6. Q(PKG): Qualitative Proprioceptive Kinematics (Gross) – ability to synthesize a number of symbolic mediations into a performance demanding the use of gross musculature while monitoring a complex physical activity involving motion.

7. Q(PSF): Qualitative Proprioceptive Sinistral (Fine) – a predominance of left-eyed, left-handed and left-footed tendencies (a typically left-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving small, or fine, musculature (e.g., writing left-handed).

8. Q(PSG): Qualitative Proprioceptive Sinstral (Gross) – a predominance of left-eyed, left-handed and left-footed tendencies (a typically left-handed person) while synthesizing a number of symbolic mediations into a performance demanding monitoring of a complex task involving large, or gross, musculature (e.g., throwing a baseball with the left hand).

9. Q(PTF): Qualitative Proprioceptive Temporal (Fine) – Ability to synthesize a number of symbolic mediations into a performance demanding the use of fine musculature while monitoring a complex physical activity involving timing.

10. Q(PTG): Qualitative Proprioceptive Temporal (Gross) – ability to synthesize a number of symbolic mediations into a performance demanding the use of gross musculature while monitoring a complex physical activity involving timing.

The remaining ten qualitative symbols associated with cultural codes are defined as:

1. Q(CEM): Qualitative Code Empathetic – sensitivity to the feelings of others; ability to put yourself in another person's place and see things from his point of view.

2. Q(CES): Qualitative Code Esthetic – ability to enjoy the beauty of an object or an idea. Beauty in his surroundings or a well-turned phrase are appreciated by a person possessing a major strength in this area.

3. Q(CET): Qualitative Code Ethic – commitment to a set of values, a group of principles, obligations and/or duties. This commitment need not imply morality. Both a priest and a criminal may be strongly committed to a set of values although the "values" may be decidedly different.

4. Q(CH): Qualitative Code Histronic – ability to exhibit a deliberate behavior, or play a role in order to produce some particular effect on other persons. This type of person knows how to fulfill role expectations.

5. Q(CK): Qualitative Code Kinesics – ability to understand, and to communicate by non-linguistic functions such as facial expressions and motions of the body (e.g., smiles and gestures).

6. Q(CKH): Qualitative Code Kinesthetic – ability to perform motor skills or to affect muscular coordination according to a recommended or acceptable form (e.g., bowling according to form, or golfing).

7. Q(CP): Qualitative Code Proxemics – ability to judge the physical and social distance that the other person would permit to exist between oneself and that other person.

8. Q(CS): Qualitative Code Synnoetics – personal knowledge of oneself.

9. Q(CT): Qualitative Code Transactional – ability to maintain a positive communicative interaction which significantly influences the goals of the persons involved in that interaction (e.g., salesmanship).

10. Q(CTM): Qualitative Code Temporal – ability to respond or behave according to time expectations imposed on an activity by members in the role-set associated with that activity.

Theoretical symbols are used in ordinary language to communicate ideas in a connected, consecutive manner according to the principles of common logic. Qualitative symbols are used to convey feelings, commitments and values, and to provide particular types of insight into the domain of self.

CULTURAL DETERMINANTS is an area in which the preferences and predispositions of students toward ways of working and ways of making decisions are assessed. Do they prefer or are they predisposed to work or make decisions in conjunction with their associates (A), in conjunction with their families or authority figures (F), or independently (I)?

MODALITIES OF INFERENCE is an area in which students are assessed concerning how they prefer to process and integrate new information into their cognitive structure. Are they categorical thinkers who are aided greatly by definitions, rules, or step-by-step procedures (M)?

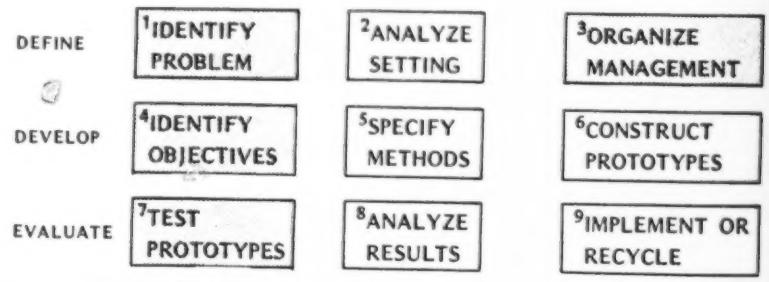
Are they most comfortable with sharp 1-to-1 contrasts, or information which tells them how new information differs from what they already know (D)? Are they most comfortable with data which relates new information to what they already know (multiple relationships) (R)? Or, are they most comfortable with a combination of these, gathering as much information as possible about a situation before a decision is made (L)?

NSMI INSTRUCTIONAL DEVELOPMENT MODEL AND COGNITIVE STYLES

Three sciences, then, based upon twenty years of research, provide information concerning how individuals come to know and, thus, how their instruction can be personalized.

This means that instructional developers not only can, but must, consider more information about each student, more individual differences in the design of instruction. This information is critical to five of the steps of the nine-step NSMI Instructional Development Model (Figure 2).

Figure 2. NSMI Instructional Development Model.



Now when an instructional developer analyzes the setting (Step 2) he must gather information about the individual differences which each student brings to the instructional situation. The methods of instruction that are selected (Step 5) must be chosen based upon the strengths and weaknesses of the students who must interact with them in order to acquire information. These strengths and weaknesses must constantly be considered as instructional materials are being constructed (Step 6). An analysis of results (Step 8) and recycling/revision/implementation decisions (Step 9) can be of value only if students' successes and failures can be related to the individual differences exhibited by these students (i.e., Cognitive Styles).

One of the main advantages of Educational Cognitive Style over other approaches to the description of individual differences is the prescriptive aspect of the approach.

Based upon research through the years, information has been gathered as to what cognitive style elements are required in a student for the student to be successful in interaction with a particular instructional situation. Some examples of general "modes of understanding of a task" (cognitive style elements required in a student for the student to be successful in interaction with a particular instructional situation) are as follows: (Hill, 1971)

INSTRUCTIONAL SITUATION A

Programmed Text

(T(VL))		(I)		(M R)
( )		( )		( )
(Q(CET))	x	(a)	x	(r m)
( )		( )		( )
(Q(CS))		( )		( )

T(VL) is the ability to gain information from the written word (very logically a part of work with a programmed text).

Q(CET) is commitment to a set of values or a group of principles (a commitment is required if a student is to successfully "work through" a programmed text).

Q(CS) is personal knowledge of oneself (needed for one to be successful in assessing his or her ability or time requirements in interacting with a programmed text).

I is an indicator of individuality (most programmed texts are utilized alone).

The (a) is an indicator of *minor* associate orientation (sometimes programmed texts are utilized with a fellow student).

M is an indicator of categorical thinking or step-by-step procedures (predictable, since a programmed text moves step-by-step).

The r is an indicator of relationships (steps in a programmed text often refer the student to previous steps — "as you recall from Step 23").

INSTRUCTIONAL SITUATION B

Seminar Designed to Enrich

(T(AL))		(F)	(R L)
( )	x	( )	x	( )
(Q(CEM))		( )	( )

T(AL) is the ability to gain information from the spoken word (logical in that a seminar has to do with spoken communication).

Q(CEM) is the ability to place oneself in the place of others and understand their feelings – empathy (it is important not to ignore the prevailing mood in a seminar).

F stands for family or an authority figure (since in a seminar designed to enrich the faculty member taking the leadership role thereby assumes the role of an authority figure).

R is an indicator of relationships (to enter into the discussion in a seminar, one must relate what one has to say with what has been said before).

L is an indicator of the ability to think about a situation in every possible mode or to understand any type thought process presented in a seminar (participants must be able to understand and respond to everything that is said by others).

INSTRUCTIONAL SITUATION C

Individualized Instruction

(	T(AL)	)		(	I	)	(	M R)
(		)		(		)	(	)
(	T(VL)	)		(		)	(	)
(		)	x	(		) x	(	)
(	Q(CS)	)		(		)	(	)
(		)		(		)	(	)
(	Q(CET)	)		(		)	(	)

Perhaps you would like to think through this one on your own. Refer to the examples above and to the definitions on pages 5–9.

Now consider the following situation which illustrates the necessity for considering more than a single variable when individualizing instruction.

The map for the "Mode of Understanding" for the seminar designed to enrich was presented earlier and is as follows:

(	T(AL)	)		(	F	)	(	R L)
(		)	x	(		) x	(	)
(	Q(CEM)	)		(		)	(	)

There's another type of seminar – one designed for producing a "rap" among students and instructors. In this situation, the instructor takes a collegial role. The map for this situation is as follows:

(	T(AL)	)		(| A |)		(| R | L |)
(| |)	x	(| |)	x	(| | |)
(	Q(CEM)	)		(| |)		(| | |)

The only difference in these two maps is in the second set; all of the elements are the same but one, yet the student who has no F in his map is very likely to be unsuccessful in a seminar designed to enrich and the student who has no A in his map is very likely to be unsuccessful in a Seminar for Rapping.

The setting is also quite important when one considers the abilities of a student to successfully interact with instruction. A student may have a very strong ability to gain information from the spoken word (T(AL)) but may be unsuccessful in gaining information from an audiotape in a learning carrel because he lacks the ability to work alone (I).

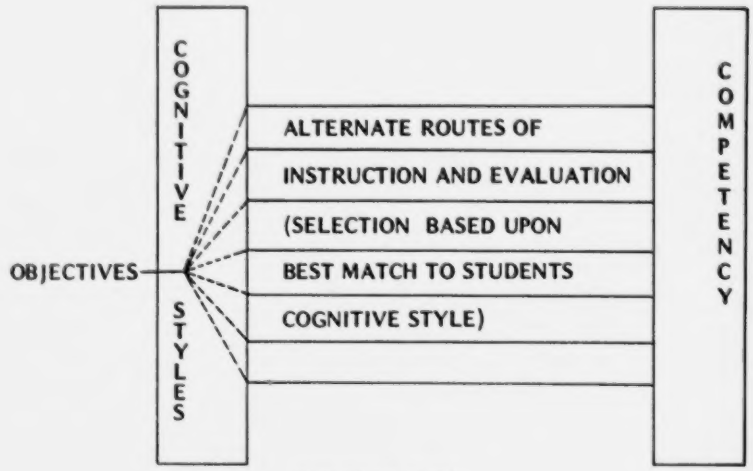
In short, we must always acquire as much information as possible about the student for whom we are designing instruction and must very carefully match instructor, instructional mode, and instructional setting to the student based upon the information we have about him (cognitive style).

No longer can the selection of instructional media be solely based upon the material to be taught. Now instructional developers must expand their planning to include answering the more precise question of which medium is most appropriate for teaching what to whom?

Instructional developers must move toward an approach similar to the one illustrated in Figure 3. In this model, the alternative routes of instruction and evaluation are defined in terms of the cognitive style elements required for a student to successfully interact with the instructional situation. Each student is guided into the alternate route which most closely matches his cognitive style.

Of the ways currently available for assessing individual differences and utilizing the information in the design of instruction, Educational Cognitive Style appears to be of greatest value. This value defines its place in instructional development.

FIGURE 3. COGNITIVE STYLE ID MODEL



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